CAIS STANDARD MANUAL

SYSTEM NO. 26
INDUSTRIAL GAS STORAGE AND DISTRIBUTION SYSTEMS

CAS PROJECT
CAIS MANUAL

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MEMORANDUM FOR DTIC-OCP
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FROM: AL/EQ (STINFO)
139 Barnes Drive. Suite 2
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SUBJECT: Transmision of Technical Documents

1. As per telephone conversation with Andrew Poulis, EQ/TIC, the attached CAIS CTDS manuals are forwarded for accession, cataloging, and microconversions. Please forward the accession numbers to:

Andrew Poulis
AL/EQ/TIC
139 Barnes Drive. Suite 2
Tyndall AFB, FL 32403-5323

2. The Distribution statement should read as follows: Approved for Public Release: Distribution Unlimited.

3. If you have questions about these documents, please contact Andrew Poulis at DSN 523-6285.

Larry L. Testerman
LARRY L. TESTERMAN
Scientific and Technical
Information Program Manager

Atchs: Manuals

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26 INDUSTRIAL GAS STORAGE AND DISTRIBUTION SYSTEM

ABSTRACT

GENERAL ORGANIZATION

At this installation the list of facilities to be surveyed, including infrastructure, will be addressed on the basis of 32 unique systems that form the CAIS Engineering Deficiency Standards and Inspection Methods document. Each system deals with a specific technical aspect of the facility to be surveyed. Within each system a further breakdown is made to subsystems, each having a related list of components. Detailed observations of the listed defects are provided so as to allow the entry of observed quantification data. A DOD CAIS manual is provided for each of the 32 systems with an internal organization as outlined below:

INSPECTOR'S GUIDE

I. General
   - A. Level I Inspection Method Description
   - B. Level II Inspection Method Description
   - C. Level III Inspection Method Description

II. General Inspection
   - A. Process. This section describes the process of the inspection activity.
   - B. Location. This section describes the procedure for locating the inspection units in the facility or infrastructure on this installation.

III. Inspector Qualifications
   This section notes the minimum qualifications for the person or persons performing the survey.

IV. Inspection Unit
   This section describes how the IU (Inspection Unit) is determined for the particular component being surveyed.

V. Unit Costs
   This section notes the nature of repair costs for this system.

VI. Standard Safety Requirements
   This section lists safety procedures and equipment required to implement a safe environment for the conduct of this survey.

VII. Standard Tools
   This section lists a set of standard tools required for the general conduct of this survey.

VIII. Special Tools and Equipment Requirements
   This section refers to special tools or equipment requirements endemic to the nature of the system being surveyed.

IX. Level II Inspection Method Keys
   This section explains the use of keys as they relate to Level II Guide Sheets.

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X. Level III Inspection Method Keys

This section explains the use of keys as they relate to Level III Guide Sheets.

XI. Replacement Cost

This section describes the nature and location of replacement cost data.

XII. Appendices

Appendix A. Provides a listing and definition of all abbreviations used both in the Standards and in the data base.

Appendix B. Provides a glossary of terms with their definitions as used in the Standard.

Appendix C. This section contains a listing of the average life cycle durations for each assembly* in the Standard.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

SYSTEM TREE

The System Tree is a graphical representation of the Work Breakdown Structure, showing system, subsystem and component relationships for the Industrial Gas Storage and Distribution System.

INSPECTION METHODS

Description

Describes the nature of what is to be condition surveyed.

Special Tool and Equipment Requirements

Lists any special tools required for this specific subsystem.

Special Safety Requirements

This section outlines any special safety measures or equipment required for this specific subsystem so as to maintain a safe environment and process in the conduct of the condition survey.

Component List

All components to be surveyed under this subsystem are listed here.

Related Subsystems

All other subsystems that have a survey relationship to this subsystem are listed here to help coordinate a complete and thorough condition assessment survey.

Standard Inspection Procedure

This statement indicates the various levels of survey effort required for this subsystem.

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Components

The previously listed components of this subsystem are described with a survey procedure recommended on a component by component basis. For each component there is a listing of defects with each defect broken down into observations describing the nature and severity of the defective condition observed. The surveyor enters a quantification value for each defect/observation encountered in the field CAIS device (DCD) to record the result of his survey.

References

This page lists the reference sources from which the foregoing subsystem data was developed.

Guide Sheet Control Number

This section lists the key numbers that tie the written Level II and Level III guide sheets to specific components in this subsystem.

Level II and Level III Inspection Method Guide Sheets

This section contains the detailed descriptions of the Level II and III survey and inspection procedures for this subsystem.

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INSPECTOR'S GUIDE

I. GENERAL

A. Level I Inspection Method

The Level I Inspection Method for Industrial Gas Storage and distribution systems consists of a thorough inspection of the industrial gas storage facilities as described in the work breakdown structure. The standard inspection is a visual walk through type inspection of the facility and is designed to be performed by one person. As some of the gas piping may be buried it cannot be inspected under a Level I inspection.

B. Level II Inspection Method

The Level II Inspection Method for Industrial Gas Storage and distribution systems consists of inspections that require some minor effort beyond the normal walk-through.

C. Level III Inspection Method

The Level III Inspection Method for Industrial Gas Storage and distribution systems consists of a more detailed inspection of the industrial gas facilities which may require vessel entry, pressure testing, and other advanced technical tests not performed during Level I and Level II inspections.

II. GENERAL INSPECTION

A. Process

The inspection is normally conducted at the component level. Figure 26-A provides the breakdown of the system through component for Industrial Gas Storage and Distribution Systems.

The inspector will work through the Work Breakdown Structure (WBS) to conduct the inspection. At the component level the inspector will be provided a list of defects, each of which is described further as observations. These observations are described to various levels of severity as they relate to the effect on the life of the system. The quantification of each deficiency is identified by the inspector using the associated unit of measure. Once an observation is populated with a deficient quantity, the inspector will be requested to provide information on component type and location. The installation date or age of the component may be preloaded into the WBS for each asset from the Real Property Inventory List or site specific information. This can be overridden by the inspector, Site CAIS personnel, or Facility Manager.

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B. Location

Level I and II inspections will be located by the inspector through a discrete entry into the Field CAIS. The "IU" (inspection unit) location will be derived from facility-supplied segment numbering lists, maps or other I.D. numbering systems. For building associated "IU's" the Facility shall furnish plans annotated with room number schedules. In the case of non-room associated components, plans will be orientated with the top of each sheet being the north direction, so as to allow directional location and description. In the case where no maps, or plans are available the inspector shall enter a brief (65 character) description of location.

III. INSPECTOR QUALIFICATIONS

Minimum inspector qualifications for the Industrial Gas Storage and Distribution Systems require a five year journeyman. Experience or familiarity in the areas of piping, valves and pressure vessels is desirable. The inspection requirements for this system can be accomplished by a single inspector, however safety and other considerations may require inspectors to work in teams. Inspectors will be specifically trained in the CAS system and its usage, and will be CAS certified.

IV. INSPECTION UNIT (IU)

The IU is normally defined at the component level. If the unit of measure at the component level is each, then the IU is each. Other units of measures are defined in Appendix A.

Each industrial gas system is to be examined separately. In the event components of differing gas systems are shared by more that one gas as in a multiple gas bottle installation, each component will be evaluated once.

V. UNIT COSTS

The unit costs that are applied to the quantities recorded for each observation are contained within the Site CAIS as repair costs.

VI. STANDARD SAFETY REQUIREMENTS

The Master Safety Plan will be followed at all times during the inspections.

Inspector may utilize the following protective gear:

- Hard hat - to be worn during all inspections
- Safety glasses - to be worn during all inspections
- Safety shoes - to be worn during all inspections
- Coveralls - to be worn as necessary
- Gloves - to be worn as necessary
- Ear plugs - to be worn in designated areas
- Knee pads - to be worn when crawling
- Rain suit - to be worn as necessary

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- Wet suit - to be worn as necessary
- Hazardous Entry permit or work permit as required
- Portable safety showers and eyewash stations
- Oxygen depletion measuring gauges (chemical stain tubes and/or Lack of Oxygen monitors.)
- Full face shield and chemical splash non-vented goggles
- Cryogenic gloves
- Chemical resistant boots
- Respirator
- Self Contained Breathing Apparatus

VII. STANDARD TOOLS

Employee Identification Card - to be worn or carried during all inspections
Data Collection Device (DCD)
Battery pack for DCD
Flashlight
Tape measure - 30'
Rule - 6'
Tool bag
Screwdrivers -
    Phillips
    Straight slot
Knife
Non sparking tools (as required for hydrogen / oxygen atmospheres)
Explosion-proof flashlight (as required for hydrogen / oxygen atmospheres)
Ammonia sulfur tapers
Chemical Concentration Measuring Tubes
Lack of Oxygen alarms
Leak check fluid

VIII. SPECIAL TOOLS AND EQUIPMENT REQUIREMENTS

At subsystem level, no special tools and equipment are required for the standard inspection of the associated components, which exceed the standard tools identified for the system. Level III Inspection Method Guide Sheets will address additional tools and equipment requirements that are specific to that particular method. Inspectors should review these sections in order to determine any special tool requirements for subsystems they are to inspect.

IX. LEVEL II INSPECTION METHOD KEYS

Certain observations will reference a Level II Inspection Method. The Facility Manager will be able to identify deficiencies where an Level II is flagged. The Level II Key at the observation level will refer to a specific Guide Sheet.

All Level II Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

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X. LEVEL III INSPECTION METHOD KEYS

Certain observations will reference a Level III Inspection Method. The Facility Manager will be able to identify deficiencies where a Level III is flagged. The Level III Key at the observation level will refer to a specific guide sheet. These guide sheets may refer the Facility Manager to a more sophisticated and costly test method.

All Level III Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

XI. REPLACEMENT COST

A replacement cost for each designated assembly will be contained within the cost estimating system in the Site CAIS.

XII. APPENDICES

Appendix A - Abbreviations

A summary and definition of all abbreviations used in this system are contained in Appendix A which is located at the end of Industrial Gas Storage and Distribution Systems.

Appendix B - Glossary

A glossary of terms used in this system are contained in Appendix B which is located at the end of Industrial Gas Storage and Distribution Systems.

Appendix C - Life Cycles

A listing of the average life cycle durations for each assembly* in the Standard.

Note - Facility Manager's Guide

The following are included in the Facility Manager's Guide:

A table showing the required manhours to perform the standard inspection for this facility listed by Cat Code (three digit).

A listing of all Level III inspections with their estimated cost and time to perform. This list will include frequency of inspection for time driven Level III's.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

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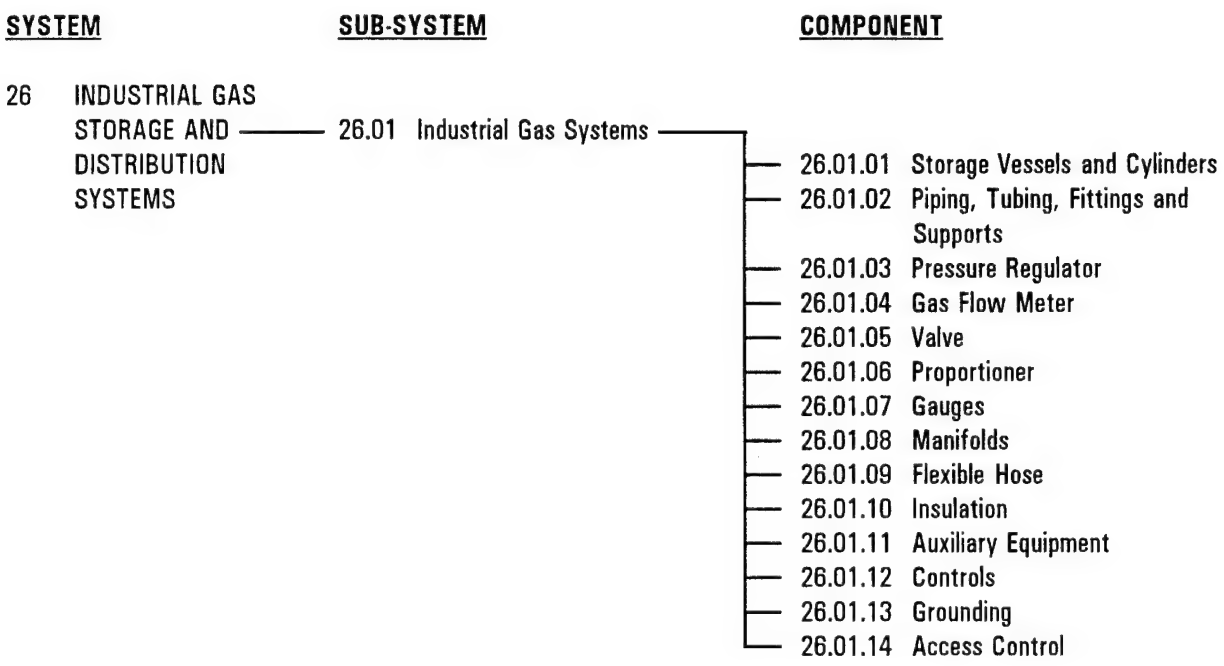
Figure 26-A. WORK BREAKDOWN STRUCTURE



26.01 INDUSTRIAL GAS SYSTEMS

DESCRIPTION

Industrial gases can be found in a variety of facilities and their uses are diverse. Gases may be supplied in their compressed gas state at high or low pressure; or in their liquified state at a variety of pressures and temperatures. The gas systems encountered usually consist of storage vessels, piping components, ancillary equipment required for system operation, control elements and end use points. The table below lists the most common gases and methods of storage for the gas in question. This list is not intended to be all inclusive as the requirements of each situation will be unique: for example solid carbon dioxide (dry ice) is used for aircraft provisions cooling and maintenance purposes. Other gases may also be used at the site that are not included in this list:

GAS	LIQUID	VAPOR	BULK STORAGE	CYLINDER STORAGE
ACETYLENE	NO	YES	YES	YES
AMMONIA	YES	YES	YES	YES
CARBON DIOXIDE	YES	NO	YES	YES
CHLORINE	YES	YES	YES	YES
HALOCARBONS	YES	YES	YES	YES
HELIUM	NO	YES	YES	YES
HYDROGEN	YES	YES	YES	YES
NITROGEN	YES	YES	YES	YES
OXYGEN	YES	YES	YES	YES

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of industrial gases beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

Inspectors shall exercise caution when inspecting the industrial gas systems at the facility. Because of the high pressure, cold temperature, inhalation hazards, oxygen depletion, flammability attributes, etc., specific to the gas being inspected extreme care shall be used during the inspection procedure. The Facility Manager shall be consulted prior to any work being performed in the area containing these gases. A list of some of the more common hazards associated with the gases is tabulated below. In no case should this table be assumed to be complete as additional hazards can be identified for each gas as well as site specific hazards. The inspector shall also be aware of the requirements of OSHA 1910.119 Process Safety Management Of Highly Hazardous Chemicals, since several of the gases commonly encountered (ammonia and chlorine in particular) are listed for particular consideration under this statute. Many of the halocarbons also require special consideration since the EPA has listed them as ozone depleting chemicals and thus require special handling and training procedures. In all cases the master safety plan will be referred to and complied with by the inspector.

26.01 INDUSTRIAL GAS SYSTEMS

GAS / HAZARD MATRIX TABLE

GAS / HAZARD	PRESSURE	TEMPERATURE	INHALATION/ OXYGEN DEPLETION	FLAMMABLE /EXPLOSIVE *
ACETYLENE	NO	NO	YES	H
AMMONIA	YES	YES	YES	L
CARBON DIOXIDE	YES	YES	YES	N
CHLORINE	YES	YES	YES	N
HALOCARBONS	YES	YES	YES	N
HELIUM	NO	YES	YES	N
HYDROGEN	YES	YES	YES	H
NITROGEN	YES	YES	YES	N
OXYGEN	YES	YES	NO	H

* H - HIGH
L - LOW
N - NONE

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENT LIST

- 26.01.01 STORAGE VESSELS AND CYLINDERS
- 26.01.02 PIPING, TUBING, FITTINGS AND SUPPORTS
- 26.01.03 PRESSURE REGULATOR
- 26.01.04 FLOW METERS
- 26.01.05 VALVES
- 26.01.06 PROPORTIONER
- 26.01.07 GAUGES
- 26.01.08 MANIFOLDS
- 26.01.09 FLEXIBLE HOSE
- 26.01.10 INSULATION
- 26.01.11 AUXILIARY EQUIPMENT
- 26.01.12 CONTROLS
- 26.01.13 GROUNDING
- 26.01.14 ACCESS CONTROL

RELATED SUBSYSTEMS

29.07	LIGHTNING PROTECTION SYSTEM
10.05	GROUNDING SYSTEMS
13.01	FENCING
09.00	FIRE PROTECTION SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspections as part of the basic inspection process. Additional Level III inspections may be indicated or "triggered" by the Level I and Level II inspection observations and should be referred to the Facility Manager for action. Associated defects and observations for each major component are listed in the inspector's Data Collection Device.

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS

◆ 26.01.01 STORAGE VESSELS AND CYLINDERS

Storage vessels are used to contain the particular gas. Because the gases under consideration are held at such a wide variety of pressures, temperatures, and physical state (liquid or gas); the vessels may be as simple as a conventional welded or seamless carbon steel cylinder containing the gas in either a liquid or gas form used for welding operations or as complex as a vacuum jacketed double wall stainless steel ASME pressure vessel used to hold liquid Hydrogen, Helium, Nitrogen or Oxygen. The welding gas type installation typically are simple installations with the cylinders supported in a cradle or by chains while more complex arrangements utilize structural steel supports or other engineered means to support the vessel and limit access to the gas. One gas, solid carbon dioxide (dry ice), is also stored in special heavily insulated boxes at atmospheric pressure. In general four type of gas installations will be encountered:

a. Non-insulated portable storage
b. Insulated portable storage
c. Non-insulated bulk storage
d. Insulated bulk storage

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Surface Deterioration:** (caused by improper operation, transportation or handling, etc.)			
Observation:			
a. Surface corrosion (surface defacing, no pitting evident).	SF		
***{Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
***{Severity M}			
c. Surface cracks of any size.	SF		1
***{Severity H}			
d. Corrosion evidenced by holes or loss of base metal.	SF		1
***{Severity H}			
e. Deteriorated coating (chipped, flaking, blistered, etc.).	SF		
***{Severity H}			
f. Burn marks or evidence of welding to vessel.	SF		1
***{Severity H}			
g. Weld defects.	LF		1
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.01 STORAGE VESSELS AND CYLINDERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Improper Markings:**			
Observation:			
a. Portable vessel test date stamping more than 5 years past current date.	EA		2
***{Severity H}			
b. ASME Code Stamp not visible.	EA		4
***{Severity H}			
Defect:			
*** Physical Damage:**			
Observation:			
a. Portable vessel valve and/or cap missing or threads deformed.	EA		2
***{Severity H}			
b. Missing chain or support not installed for portable vessels.	EA	1	
*** {Severity H}			
c. Leak indicated by smell, severe corrosion, gas clouds, etc.	EA		1
***{Severity H}			
d. Adequate support of bulk vessels	EA		3
***{Severity H}			
e. ASME relief valve(s) not installed or missing	EA		5
***{Severity H}			
f. Missing jacketing or broken insulation.	SF		6
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.02 PIPING, TUBING, AND FITTINGS

The interconnecting piping system including the joints and fittings for the industrial gas systems deliver the gas from the storage area to the point of use. Because of the nature of the gases involved, simple soap solutions are not adequate to detect leakage. Engineered leak check fluids containing wetting agents are used to identify leaks by the formation of bubbles at leaking connections. In no case should flame producing leak check methods be employed except for the use of sulfur tapers in testing ammonia systems.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident).	SF		
***{Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
***{Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		7
***{Severity H}			
Defect:			
*** Physical Wear and Tear or Abuse:**			
Observation:			
a. Not level and plumb.	LF		
***{Severity L}			
b. Leaks, minor, drips.	LF		
***{Severity L}			
c. Loose supports.	LF		
***{Severity L}			
d. Loose joints, drips.	LF		
***{Severity M}			
e. Cracks of any size.	LF		8
***{Severity H}			
f. Crimped expansion joints.	EA		9
***{Severity H}			
g. Excessive restraint impeding cold piping contraction.	EA		10
***{Severity H}			
h. Missing or leaking sleeves through walls or floors.	EA		11
***{Severity H}			
i. Major leaks, puddles.	EA		12
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.03 PRESSURE REGULATOR

Pressure regulators reduce the high pressure gas that is required for economical storage to a usable level. Regulators may be used either singularly or in series to reduce the pressure.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Physical Wear and Tear or Abuse:**			
Observation:			
a. Noisy operation.	EA		
***{Severity M}			
b. Bent actuator.	EA		
***{Severity H}			
c. Missing control element.	EA		
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.04 FLOW METER

Flow meters are used to either give a visual indication of the gas' use at a particular time or to totalize the use over a time period.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Physical Wear and Tear or Abuse:**			
Observation:			
a. Leaking of any fluid.	EA		13
***{Severity H}			
b. Installed with improper flow direction.	EA		13
***{Severity H}			
Defect:			
* **Improper Operations:**			
Observation:			
a. Noisy operation (gurgling, rattles, etc.)	EA		
*** {Severity M}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.05 VALVES

Valves are used in the system to isolate sections of the piping system from other sections so only certain sections may be operated; to isolate another component for repair; control flow rate; control flow direction; provide safety relief.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Wear and Tear or Abuse:**			
Observation:			
a. Leaking connections.	EA		14
***{Severity H}			
b. Leaking body/packing.	EA		14
***{Severity H}			
c. Bent stem.	EA		14
***{Severity H}			
d. Actuator not operative.	EA		14
***{Severity H}			
e. Freeze bulge.	EA		14
***{Severity H}			
Defect:			
*** Missing Relief Valves or Tags:**			
Observation:			
a. Missing relief valve.	EA		5
***{Severity H}			
b. ASME tag detached.	EA		5
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.06 PROPORTIONER

Proportioners are used in certain gas systems to allow the blending of two gases at a predetermined or adjustable ratio.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Physical Wear and Tear or Abuse:**			
Observation:			
a. Noisy operation.	EA		
***{Severity M}			
b. Bent actuator.	EA		15
***{Severity H}			
c. Missing control element.	EA		15
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.07 GAUGES

Gauges give a visual indication of the certain physical properties (pressure, temperature, dewpoint, etc., that the gas possess at a given time.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Wear and Tear or Abuse:**			
Observation:			
a. Leaking stem.	EA		16
***{Severity H}			
b. Leaking body.	EA		16
***{Severity H}			
c. Cracked glass.	EA		16
***{Severity H}			
d. Pegged needle, no movement.	EA		16
***{Severity H}			
e. Illegible scale.	EA		16
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.08 MANIFOLDS

Manifolds are used to interconnect multiple portable containers so as to lengthen the available time that a gas system can be used before shutdown to change-over to another storage container. Manifolds are normally constructed from pipe and tubing with interconnecting fittings between storage containers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Wear and Tear or Abuse:**			
Observation:			
a. Improperly supported.	EA		
***{Severity M}			
b. Leaking connections.	EA		12
***{Severity H}			
c. Bulged connection.	EA		12
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.09 FLEXIBLE HOSE

Flexible hoses are used to connect the storage container(s) to other portions of the system for either filling or withdrawal of the gas.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Wear and Tear or Abuse:**			
Observation:			
a. Not supported properly.	EA		
***{Severity M}			
b. Leaking joints.	EA		17
***{Severity H}			
c. Leaking body.	EA		17
***{Severity H}			
d. Deformed, crimped.	EA		
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.10 INSULATION

Insulation systems are installed to keep the gas at a certain temperature. Insulation may be very simple such as a single layer of elastomeric foam used for temperatures of 30 to 50 degrees F. to high vacuum double wall insulation systems utilized for low temperature liquified gases like helium and hydrogen.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Insulation Damage:**			
Observation:			
a. Missing jacketing.	LF		
***{Severity M}			
b. Wet insulation.	LF		18
***{Severity H}			
c. Missing insulation.	LF		18
***{Severity H}			
d. Damaged/torn insulation.	LF		18
***{Severity H}			
e. Frozen insulation.	LF		18
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.11 AUXILIARY EQUIPMENT

Since many of the gases utilized are shipped and stored in a liquified state, the liquid must be transformed into a gas. This is accomplished through the use of a vaporizer. The vaporizer provides heat to the liquid and allows the liquid to boil and change into the gaseous state. The heat for the vaporizer can come from: the ambient air surrounding the storage vessel; directly through a heat exchanger utilizing a heat source; or through an indirect heat exchanger using a heat transfer medium heated by a heat source.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Physical Wear and Tear or Abuse:**			
Observation:			
a. Compressor cooler fins damaged or bent.	EA		
***{Severity M}			
b. Leaking vaporizer.	EA		19
***{Severity H}			
c. Frozen vaporizer.	EA		19
***{Severity H}			
d. Vaporizer heater not operational.	EA		20
***{Severity H}			
e. Pumps not operational.	EA		21
***{Severity H}			
f. Pumps leaking.	EA		21
***{Severity H}			
g. Noisy operation of pump.	EA		21
***{Severity H}			
h. Pressurization compressor not operational.	EA		22
***{Severity H}			
i. Pressurization compressor leaking.	EA		22
***{Severity H}			
j. Noisy operation of pressurization compressor.	EA		22
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.12 CONTROLS

The controls for gas systems consist primarily of pressure, temperature and flow.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Physical Damage:**			
Observation:			
a. Pressure control element not operational.	EA		23
***{Severity H}			
b. Temperature control element not operational.	EA		23
***{Severity H}			
c. Flow control element not operational.	EA		23
***{Severity H}			
d. Pressure control valve not operational.	EA		23
***{Severity H}			
e. Temperature control valve not operational.	EA		23
***{Severity H}			
f. Flow control valve not operational.	EA		23
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.13 GROUNDING

Industrial gas systems like other tankage and distribution systems require adequate electrical grounding to satisfy electrical constraints as well as reduce static discharges that can induce spurious control signals or ignitions of flammable gases.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Physical Wear and Tear or Abuse:**			
Observation:			
a. Grounding straps or cable not installed. *** {Severity H}	EA		
b. Loose connections between equipment and ground loop. ***{Severity H}	EA		

26.01 INDUSTRIAL GAS SYSTEMS

COMPONENTS (Continued)

◆ 26.01.14 ACCESS CONTROL

Industrial gas systems normally are not stand alone items but rather are incorporated within other facilities. As such, the physical location and installation considerations are also subject to inspection as they relate to the gas system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Wear and Tear or Abuse:**			
Observation:			
a. Access fence and gate not installed.	LF		
***{Severity H}			
b. Gate locked, key unavailable.	EA		
***{Severity H}			
c. Gate inoperable.	EA		
***{Severity H}			
d. Warning signs not posted at each entrance.	EA		
***{Severity H}			
Defect:			
*** Safety Related Considerations:**			
Observation:			
a. Eyewash station not installed.	EA		
***{Severity H}			
b. Eyewash station not operable.	EA		
***{Severity H}			
c. Exterior eyewash station not heat traced.	EA		
***{Severity H}			
d. Fire protection system not installed or inoperable.	EA		
***{Severity H}			

26.01 INDUSTRIAL GAS SYSTEMS

REFERENCES

1. Handbook of Compressed Gases, Compressed Gas Association, Inc.
2. OSHA 1910.119 Process Safety Management Of Highly Hazardous Chemicals
3. ASME Boiler and Pressure Vessel Code Section VIII
4. UL 567 Pipe Connections for Flammable or Combustible Liquids and LP-Gas
5. NFPA 45 Fire Protection for Laboratories Using Chemicals

26.01 INDUSTRIAL GAS SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 26.01.01-1

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 26.01.01-1
2	GS-III 26.01.01-2
3	GS-III 26.01.01-3
4	GS-III 26.01.01-4
5	GS-III 26.01.01-5
6	GS-III 26.01.01-6
7	GS-III 26.01.02-7
8	GS-III 26.01.02-8
9	GS-III 26.01.02-9
10	GS-III 26.01.02-10
11	GS-III 26.01.02-11
12	GS-III 26.01.02-12
13	GS-III 26.01.04-13
14	GS-III 26.01.05-14
15	GS-III 26.01.06-15
16	GS-III 26.01.07-16
17	GS-III 26.01.09-17
18	GS-III 26.01.10-18
19	GS-III 26.01.11-19
20	GS-III 26.01.11-20
21	GS-III 26.01.11-21
22	GS-III 26.01.11-22
23	GS-III 26.01.12-23
24*	GS-III 26.01-24*
25*	GS-III 26.01-25*

* *Indicates guide sheets which are not directly referenced by a Key. These are triggered by information beyond the inspection process such as time, age or repeated service calls.*

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: STORAGE VESSEL AND CYLINDERS
CONTROL NUMBER: GS-II 26.01.01-1

Application

This guide applies to the inspection of safety chains for portable cylinders

Special Safety Requirements

No special safety requirements are needed for the performance of this Level inspection beyond those listed in the Master Safety Plan and in the Standard Safety Requirements section of the System Inspector's Guide.

Inspection Actions

1. Locate safety chain and reinstall chain required to stabilize cylinders. If chain cannot be found initiate a level III inspection and fabrication of chain.

Recommended Inspection Frequency

As required by Level I deficiency observation

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: STORAGE VESSELS AND CYLINDERS
CONTROL NUMBER: GS-III 26.01.01-1

Application

This guide applies to the inspection of storage vessels and cylinders for cracks, corrosion, weld marks, or other physical damage.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

Any cracks, corrosion, weld marks, or burning observed during the inspection of vessels and cylinders imply the impending serious failure of the vessel.

The Facility Manager should be consulted to the ownership of the vessel. If the vessel is leased or supplied by a gas supplier, the supplier should be notified immediately to have the vessel repaired or removed. If the vessel is government owned, a qualified inspector should be contracted to inspect the vessel in accordance with the site's governing code. Larger vessels are normally ASME code stamped units and as such, pressure testing or other Nondestructive (NDE) techniques must be employed to prove the soundness of the vessel. The test shall be performed in accordance with applicable ASME code utilizing the prescribed test protocol.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Pressure building pumps or compressors
2. NDE testing equipment
3. Leak check fluid
4. Dye Penetrant
5. Test fluid

Recommended Inspection Frequency

When triggered by Level I or II Defect/Observation.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: STORAGE VESSELS AND CYLINDERS
CONTROL NUMBER: GS-III 26.01.01-1

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: STORAGE VESSELS AND CYLINDERS
CONTROL NUMBER: GS-III 26.01.01-2

Application

This guide applies to the inspection of portable storage vessels and cylinders for test date and missing valve caps.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

Portable vessels must be inspected every five years and have the information so stamped onto the vessel. Caps must also be installed to prevent damage to the outlet valve.

The test Facility Manager should be consulted as to the ownership of the vessel. If the vessel is leased or supplied by a gas supplier, the supplier should be notified immediately to have the vessel repaired or removed. If the vessel is government owned, a qualified inspector should be contracted to inspect the vessel in accordance with the site's governing code.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Pressure building pumps or compressors
2. NDE testing equipment
3. Leak check fluid
4. Dye Penetrant
5. Test fluid

Recommended Inspection Frequency

Five Years

References

1. Handbook of Compressed Gases

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: STORAGE VESSELS AND CYLINDERS
CONTROL NUMBER: GS-III 26.01.01-3

Application

This guide applies to the inspection of storage vessels and cylinders for adequate support.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

Bulk storage containers should be further inspected to insure that any supports welded to the vessels have not deteriorated due to rust. Concrete supported vessels should be inspected to insure that saddles, etc have not tilted. The Facility Manager should be consulted as to the ownership of the vessel. If the vessel is leased or supplied by a gas supplier, the supplier should be notified immediately to have the vessel repaired or removed. If the vessel is government owned, a qualified inspector should be contracted to inspect the vessel in accordance with the site's governing code. The metal support structure shall be gauged using a ruler to determine the current thickness. The vessel's shop drawing shall be utilized to determine the extent of the support supplied with the vessel and then compared with the vessel to ascertain if material deterioration has occurred. Likewise any concrete structure shall be checked and compared to the design documents to ascertain the current condition of the support vis a vis the original design condition.

1. Lock out system
2. Using calipers or straight edge, gauge measure support thickness.
3. Compare thickness with shop drawings
4. Use carpenter's level to check concrete saddle level

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Dye Penetrant
2. Calipers or other thickness gauge
3. Carpenter's level

Recommended Inspection Frequency

When triggered by a Level I or Level II Defect/Observation.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: STORAGE VESSELS AND CYLINDERS
CONTROL NUMBER: GS-III 26.01.01-3

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: STORAGE VESSELS AND CYLINDERS
CONTROL NUMBER: GS-III 26.01.01-4

Application

This guide applies to the inspection of storage vessels and cylinders for visible presentation of the ASME code stamp.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

The Facility Manager should be consulted as to the ownership of the vessel. If the vessel is leased or supplied by a gas supplier, the supplier should be notified immediately to have the vessel repaired or removed. If the vessel is government owned, a qualified inspector should be contracted to inspect the vessel in accordance with the site's governing code. The vessel's shop drawing shall be utilized to determine if in fact the vessel is an ASME vessel. If the vessel is a code stamp, it shall be inspected using the original drawing to verify that the vessel still can carry the code stamp.

1. Lock out system
2. Using shop drawing, locate the ASME stamp and verify that it is still attached

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

NONE

Recommended Inspection Frequency

Every five years.

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: STORAGE VESSELS AND CYLINDERS
CONTROL NUMBER: GS-III 26.01.01-5

Application

This guide applies to the inspection of storage vessels and cylinders for the installation of ASME relief valves.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

Bulk storage containers should be inspected to insure that all ASME storage vessels are protected by ASME code stamped relief valves. The Facility Manager should be consulted as to the ownership of the vessel. If the vessel is leased or supplied by a gas supplier, the supplier should be notified immediately to have the vessel repaired or removed if the inspection identifies a vessel to be lacking relief valves. If the vessel is government owned, a qualified inspector should be contracted to inspect the vessel in accordance with the site's governing code. The vessel's shop drawing shall be utilized to determine if in fact the vessel is an ASME vessel. If the vessel is a code stamp vessel, it shall be inspected using the original drawing to verify that the vessel is still protected by the installation of relief valves. The inspector shall compare the flow capacity on the relief valve(s) with that noted on the drawing. If the installed relief valve(s) are not the correct capacity the valves shall be replaced with the proper valving. Every five years the vessel shall have the relief valves removed and tested or the reliefs shall be replaced with new relief valves. Relief valves cannot be tested in the field but must be removed and tested in an ASME approved facility.

1. Lock out system
2. Using the shop drawing, locate relief values
3. Compare relief valves design data to installed valving

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. New relief valves

Recommended Inspection Frequency

Five years

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: STORAGE VESSELS AND CYLINDERS
CONTROL NUMBER: GS-III 26.01.01-5

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation
5. Anderson Greenwood Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: STORAGE VESSELS AND CYLINDERS
CONTROL NUMBER: GS-III 26.01.01-6

Application

This guide applies to the inspection of storage vessels and cylinders for damaged due to the failure or removal of insulation or insulation jacketing.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

Storage containers should be inspected to insure that any storage vessel requiring insulation is so insulated. The Facility Manager should be consulted as to the ownership of the vessel. If the vessel is leased or supplied by a gas supplier, the supplier should be notified immediately to have the vessel repaired or removed if the inspection identifies a vessel to be damaged due to damage from insulation damage or removal. If the vessel gives indication of metal loss due to corrosion the vessel shall be tested for metal thickness by a certified inspector using ultrasonic, dye penetrant or other approved testing methods.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Pressure building pumps or compressors
2. NDE testing equipment
3. Leak check fluid
4. Dye Penetrant
5. Test fluid
6. Ultrasonic or other gaging tools

Recommended Inspection Frequency

When triggered by Level I or Level II Defect/Observation.

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7

COMPONENT: PIPING, TUBING AND FITTINGS
CONTROL NUMBER: GS-III 26.01.02-7

Application

This guide applies to the inspection of piping, tubing and fittings showing deterioration due to loss of base metal, holes, etc.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

Any evidence of deterioration due to loss of base metal, holes, etc of piping or fittings should entail the replacement of the affected system.

1. Verify location and nature of metal loss
2. Measure depth, diameter at length of metal loss.
3. Mark location
4. Inform Facility Manager of need for replacement and estimated cost.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Pressure building pumps or compressors
2. NDE testing equipment
3. Leak check fluid
4. Dye Penetrant
5. Test fluid

Recommended Inspection Frequency

When triggered by Level I or Level II Defect/Observation.

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8

COMPONENT: PIPING, TUBING AND FITTINGS
CONTROL NUMBER: GS-III 26.01.02-8

Application

This guide applies to the inspection of piping tubing and fittings showing severe cracking due to thermal cycling.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

Any evidence of cracking of piping or fittings should entail the replacement of the affected components.

1. Verify location and nature of crack
2. Measure depth and length of crack
3. Mark crack location
4. Inform Facility Manager of need for replacement and estimated cost.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Pressure building pumps or compressors
2. NDE testing equipment
3. Leak check fluid
4. Dye Penetrant
5. Test fluid

Recommended Inspection Frequency

NONE

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9

COMPONENT: PIPING, TUBING AND FITTINGS
CONTROL NUMBER: GS-III 26.01.02-9

Application

This guide applies to the inspection of piping systems where expansion joints are damaged due to crimping or deformation.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate deformed or crimped joint
2. Lock out system
3. Inform Facility Manager of need for replacement if adjustment is not practical.
4. Prepare estimate of cost to correct

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Pressure building pumps or compressors
2. NDE testing equipment
3. Leak check fluid
4. Dye Penetrant
5. Test fluid

Recommended Inspection Frequency

NONE

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10

COMPONENT: PIPING, TUBING AND FITTINGS
CONTROL NUMBER: GS-III 26.01.02-10

Application

This guide applies to the inspection of piping, tubing and fittings showing undue restraint due to thermal cycling.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate tight member and identify cause of restraint problem
2. Lock out system
3. Inform Facility Manager of need for replacement of adjustment as required
4. Prepare estimate of cost to correct

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Pressure building pumps or compressors
2. NDE testing equipment
3. Leak check fluid
4. Dye Penetrant
5. Test fluid

Recommended Inspection Frequency

NONE

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11

COMPONENT: PIPING, TUBING AND FITTINGS
CONTROL NUMBER: GS-III 26.01.02-11

Application

This guide applies to the inspection of floor and wall sleeves carrying piping and tubing showing leaks at walls or floors.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Locate and identify the nature of the leak in sleeves
2. Check for broken water barrier or sleeve
3. Inform Facility Manager of need for replacement and associated cost to correct the leak(s).

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Pressure building pumps or compressors
2. NDE testing equipment
3. Leak check fluid
4. Dye Penetrant
5. Test fluid
6. Cutting tools
7. Barrier bonding materials
8. Concrete tools

Recommended Inspection Frequency

NONE

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12

COMPONENT: PIPING, TUBING AND FITTINGS
CONTROL NUMBER: GS-III 26.01.02-12

Application

This guide applies to the inspection of piping, tubing and fittings showing evidence of major leaks.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

Any evidence of leaking piping or fittings should entail the replacement of the affected system.

1. Verify leak location and nature
2. Lock out system
3. Inform Facility Manager of need for replacement and estimated cost of correction.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Pressure building pumps or compressors
2. NDE testing equipment
3. Leak check fluid
4. Dye Penetrant
5. Test fluid

Recommended Inspection Frequency

NONE

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 13

COMPONENT: FLOW METERS
CONTROL NUMBER: GS-III 26.01.04-13

Application

This guide applies to the inspection of leaking, improper operation or physical damage.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Remove counter and cover and check rotor lock nuts for tightness. If nuts are loose, check the rotor shaft keyway for wear.
2. Check rotor bearings for wear
3. Check rotor journals for wear
4. Check timing gears for wear
5. Inform Facility Manager of conditions found and estimated cost to correct.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. NONE

Recommended Inspection Frequency

When triggered by a Level I or Level II Defect/Observation.

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 14

COMPONENT: VALVES
CONTROL NUMBER: GS-III 26.01.05-14

Application

This guide applies to the inspection of manual valves that leak and are difficult to operate or have freeze bulges.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and in the Standard Safety Requirements section of the System Inspector's Guide.

Inspection Actions

1. Inspect valve for leaking bonnet or flanges.
2. Check if valve stem is binding due to gland nuts being too tight.
3. Dismantle valve assembly. Depending on valve type, the valve body may or may not need to be removed from the piping.
4. Check for dirt or foreign matter between the valve seat and the seating surfaces of the valve disk/ball/plug.
5. Inspect valve disk/ball/plug for damage.
6. Check if valve stem is bent.
7. Check for loose disks and guide assemblies.
8. Check for corrosion buildup that could interfere with valve operation.
9. Check for frozen water in valve body.
10. Advise Facility Manager of conditions found and estimated cost to repair.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 14 (Continued)

COMPONENT: VALVES
CONTROL NUMBER: GS-III 26.01.05-14

Special Tools and Equipment

Listed below are special tools and equipment, beyond those listed in the Standard Tools section of the Introduction and System Inspector's Guide, that are required to perform this Level III inspection:

1. Special tools as recommended by the valve manufacturer

Recommended Inspection Frequency

When triggered by a Level I or Level II Defect/Observation.

References

1. NAVFAC MO-230, Maintenance and Operation of Petroleum Fuel Facilities, August 1990
2. NAVFAC MO-322, Volume II, Inspection of Shore Facilities, January 1993
3. DOE Condition Assessment Survey (CAS) Program, Deficiency Standards and Inspections Methods Manual, Volume 8
4. Operation and maintenance manual from the valve manufacturer
5. NAVFAC P-717.0, Engineered Performance Standards for Real Property Maintenance Activities, Preventive/Recurring Maintenance Handbook

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 15

COMPONENT: GAS PROPORTIONERS
CONTROL NUMBER: GS-III 26.01.06-15

Application

This guide applies to the inspection of valves that leak at the valve seat.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and in the Standard Safety Requirements section of the System Inspector's Guide.

Inspection Actions

1. Dismantle valve assembly. Depending on valve type, the valve body may or may not need to be removed from the piping.
2. Check for dirt or foreign matter between the valve seat and the seating surfaces of the valve disk/ball/plug.
3. Inspect valve disk/ball/plug for wear, cuts, cracks, corrosion, etc.
4. Inspect valve seats for wear, cuts, cracks, corrosion, etc.
5. Check for loose disks and guide assemblies.
6. Check for corrosion buildup that could interfere with valve operation.
7. Inspect plug valves for incorrect adjustment.
8. In diaphragm-type valves, check diaphragm for wear, cuts and ruptures.
9. Check for defective spring in diaphragm and relief valves.
10. Check for dirt or frozen moisture in pilot tubing and pilot valves.
11. Check pilot system strainer.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 15 (Continued)

COMPONENT: GAS PROPORTIONERS
CONTROL NUMBER: GS-III 26.01.06-15

Special Tools and Equipment

Listed below are special tools and equipment, beyond those listed in the Standard Tools section of the Introduction and System Inspector's Guide, that are required to perform this Level III inspection:

1. Special tools as recommended by the proportioner manufacturer

Recommended Inspection Frequency

When triggered by a Level I or Level II Defect/Observation.

References

1. NAVFAC MO-230, Maintenance and Operation of Petroleum Fuel Facilities, August 1990
2. NAVFAC MO-322, Volume II, Inspection of Shore Facilities, January 1993
3. DOE Condition Assessment Survey (CAS) Program, Deficiency Standards and Inspections Methods Manual, Volume 8
4. Operation and maintenance manual from the valve manufacturer
5. NAVFAC P-717.0, Engineered Performance Standards for Real Property Maintenance Activities, Preventive/Recurring Maintenance Handbook

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 16

COMPONENT: GAUGES
CONTROL NUMBER: GS-III 26.01.07-16

Application

This guide applies to the inspection of pressure and temperature gauges that leak or do not operate.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and in the Standard Safety Requirements section of the System Inspector's Guide.

Inspection Actions

1. If the gauge has an isolation valve, verify that the valve is open, observe operation of gauge.
2. Check for gas leaks with appropriate fluid type detection methods.
3. If the valve remains inoperative, close the valve.
4. Obtain the services of a trained technician to complete the inspection.
5. Notify Facility Manager of conditions found and estimated cost to correct.

Special Tools and Equipment

No special tools and equipment, except leak detection fluid and a brush, are required beyond those listed in the Standard Tools section of the Introduction and System Inspector's Guide, are required to perform this Level III inspection.

Recommended Inspection Frequency

As triggered by Level I or Level II Defect/Observation.

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 17

COMPONENT: FLEXIBLE HOSE
CONTROL NUMBER: GS-III 26.01.09-17

Application

This guide applies to the inspection of flexible hose that leaks or is deformed.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Inspect hose for leaks at ends
2. Inspect hose for leaks in the main body
3. Bleed gas from system
4. Remove hose and inspect interior for rips or tears.
5. If above does not identify leak, pressure test hose per ASTM standards for service used.
6. Advise Facility Manager of conditions found and estimated cost to correct.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Pressure building pumps or compressors
2. NDE testing equipment
3. Leak check fluid
4. Dye Penetrant
5. Test fluid

Recommended Inspection Frequency

NONE

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 18

COMPONENT: INSULATION
CONTROL NUMBER: GS-III 26.01.10-18

Application

This guide applies to the inspection of damaged insulation.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Remove jacketing to expose insulation.
2. Inspect for frozen water, liquid water or fractured insulation
3. Note location and install temporary cover
4. Inform Facility Manager of conditions and estimated cost to correct.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Insulation, jacketing and mastic

Recommended Inspection Frequency

NONE

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 19

COMPONENT: AUXILIARY EQUIPMENT
CONTROL NUMBER: GS-III 26.01.11-19

Application

This guide applies to the inspection and replacement of damaged gas vaporizers.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Observe operation to see if liquified gas is converted to gas.
2. Shut down and lock out disconnect.
3. Isolate unit and purge liquified gas.
4. Inspect housing for cracks, fatigue, erosion, and corrosion.
5. Check heater operation
6. Check water pump operation if applicable
7. Check thermostat and/or control valve.
8. Inform Facility Manager of conditions found and estimated cost to correct.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Manufacturer's recommended tools

Recommended Inspection Frequency

NONE

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 20

COMPONENT: AUXILIARY EQUIPMENT
CONTROL NUMBER: GS-III 26.01.11-20

Application

This guide applies to the inspection of non-heating gas vaporizer heaters.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check operation to see if liquid is converted to gas.
2. Shut down and lock out disconnect.
3. Isolate unit and purge gas.
4. Check heater operation.
5. Check water pump operation if applicable.
6. Check direct fired unit if applicable.
7. Check thermostat and/or control valve.
8. Inform Facility Manager of conditions found and estimated cost to correct.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Manufacturer's standard tools

Recommended Inspection Frequency

NONE

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 21

COMPONENT: AUXILIARY EQUIPMENT
CONTROL NUMBER: GS-III 26.01.11-21

Application

This guide applies to the inspection of liquified gas pumps.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Observe operation and determine possible source of damage.
2. Perform vibration analysis on bearings.
3. Shut down and lock out disconnect.
4. Isolate unit and purge liquified gas.
5. Inspect housing for cracks, fatigue, erosion, and corrosion.
6. Check shafting for signs of fatigue.
7. Check shafting for damage from packing/mechanical seal.
8. Check impellers (pistons) for erosion/corrosion, physical damage, distortion.
9. Rotate (cycle) shafting and check for distortion in shaft.
10. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
11. Advise Facility Manager of conditions found and estimated cost to correct.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Manufacturer's standard, analysis tool list from product operation and maintenance manual. (Varies by product manufacturer.)

Recommended Inspection Frequency

When triggered by Level I or Level II Defect/Observation.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 21 (Continued)

COMPONENT: AUXILIARY EQUIPMENT
CONTROL NUMBER: GS-III 26.01.11-21

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 22

COMPONENT: AUXILIARY EQUIPMENT
CONTROL NUMBER: GS-III 26.01.11-22

Application

This guide applies to the inspection of non-functional or leaking, gas compressor.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Observe operation and determine possible source of damage.
2. Perform vibration analysis on bearings.
3. Shut down and lock out disconnect.
4. Isolate unit and purge liquified gas.
5. Inspect housing for cracks, fatigue, erosion, and corrosion.
6. Check shafting for signs of fatigue.
7. Check shafting for damage from packing/mechanical seal.
8. Check impellers (pistons) for erosion/corrosion, physical damage, distortion.
9. Rotate (cycle) shafting and check for distortion in shaft.
10. Check clearances between piston and cylinder; compare with manufacturer's specifications.
11. Advise Facility Manager of conditions found and estimated cost to correct.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Manufacturer's standard analysis tool list from product operation and maintenance manual. (varies by product manufacturer)

Recommended Inspection Frequency

When triggered by Level I or Level II Defect/Observation.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 22 (Continued)

COMPONENT: AUXILIARY EQUIPMENT
CONTROL NUMBER: GS-III 26.01.11-22

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 23

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 26.01.12-23

Application

This guide applies to the inspection of control elements.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Observe operation and determine the nature and cause of the abnormality observed.
2. Inspect pressure controller for proper operation.
3. Inspect temperature controller for proper operation.
4. Inspect flow controller for proper operation.
5. Inspect transmitters for proper operation and sealing range.
6. Check transmission tubing for obstructions and transmitter wiring for continuity.
7. Stroke valves, confirm full range operation.
8. Isolate valves and purge of gas.
9. Disassemble valves and inspect inferior components and seals.
10. Advise Facility Manager of conditions found and estimate cost to correct.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Manufacturer's standard

Recommended Inspection Frequency

NONE

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 24*

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 26.01.12-24*

Application

This guide applies to the inspection and replacement of damaged gas dryers.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Observe operation and determine possible source of damage.
2. Shut down and lock out disconnect.
3. Isolate unit and purge gas.
4. Inspect housing for cracks, fatigue, erosion, and corrosion.
5. Inspect filter media for tears, rupturing, clogging, etc
6. Replace filter media as required
7. Inspect drains for proper operation
8. Advise Facility Manager of conditions found and estimate cost to correct.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Manufacturer's standard analysis tool kit from product operation and maintenance manual. (varies by product manufacturer)

Recommended Inspection Frequency

Three years.

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 25*

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 26.01.12-25*

Application

This guide applies to the inspection and replacement of damaged gas filters.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Observe operation and determine possible source of damage.
2. Shut down and lock out disconnect.
3. Isolate unit and purge gas.
4. Inspect housing for cracks, fatigue, erosion, and corrosion.
5. Inspect filter media for tears, rupturing, clogging, etc
6. Replace filter media as required
7. Inspect drains for proper operation
8. Advise Facility Manager of conditions found and estimate cost to correct.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Manufacturer's standard analysis tool kit from product operation and maintenance manual. (varies by product manufacturer)

Recommended Inspection Frequency

Three years.

References

1. ASME Boiler and Pressure Vessel Code Section VIII
2. Handbook of Compressed Gases
3. Means Facilities Maintenance and Repair Cost Data, 1994
4. Sverdrup Corporation

APPENDIX A

ABBREVIATIONS

A/E	Architect-Engineer
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASHRAE	American Society of Heating, Ventilating, and Air-Conditioning Engineers
AVG	Average
BLDG	Building
BOCA	Building Official Code Association
CS	Carbon steel
CSI	Construction Specification Institute
DCD	Data Collection Device
DIA	Diameter
DOT	Department of Transportation
EA	Each
ETC	Etcetera
°F	Degrees Fahrenheit
Ft	Foot, feet
IU	Inspection Unit
LF	Linear Feet
NDE	Non-Destructive Testing
NFPA	National Fire Protection Association
OD	Outside Diameter
OSHA	Occupational Safety and Health Administration

APPENDIX A

PSIG	Pounds Per Square Gage
PVC	Polyvinyl Chloride
QA	Quality Assurance
Reqd	Required
REPL	Replace
SF	Square feet
SIM	Standard Inspection Method
SS	Stainless Steel
UOM	Unit of Measure
Yrs	Years

APPENDIX B

GLOSSARY

Accessible	Capable of being removed or exposed without damaging the building structure or finish, or not permanently closed in by the structure or finish of the building.
Buildings	A structure which stands alone or which is cut off from adjoining structures by fine walls with all openings therein protected by approved fire doors.
Cylinder	A portable container constructed to DOT specifications or in larger sizes to the ASME code. The maximum size permitted under the DOT rules is 1000 pounds water capacity.
Equipment	A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like used as a part of, or in connection with, an installation.
Excess Flow Valve	A valve designed to close when the flow as measured by pressure drop exceeds a predetermined settings.
Flexible Connector	A short (36 inch or less) piping fitting fabricated of rubber hose or metal used to connect parts of the piping system.
Fitting	An accessory such as a tee, elbow, flange or other pressure part of the system.
Relief Valve	A devise to release pressure from a vessel or cylinder.
Vaporizer	A device which receives liquified gas and through the addition of heat converts the liquid to a gaseous form.
Vessel	A storage container fabricated to the ASME code.

APPENDIX C

LIFE CYCLE

26 INDUSTRIAL GAS STORAGE AND DISTRIBUTION SYSTEMS

26.01 INDUSTRIAL GAS SYSTEMS

Storage Vessels and Cylinders	30 YRS
Piping, Tubing, and Fittings and Supports	30 YRS
Pressure Regulator	15 YRS
Flow Meters	15 YRS
Valves	15 YRS
Proportioner	15 YRS
Gauges	15 YRS
Manifolds	30 YRS
Flexible hose	15 YRS
Insulation	15 YRS
Controls	15 YRS
Grounding	50 YRS
Access Control	40 YRS

Source:
MEANS Facilities Maintenance & Repair Cost Data